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Diversity and perception of medicinal plants used by the Costa Rican population

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Abstract
Medicinal plants have become an important source for the treatment of various diseases. In Costa Rica, a survey conducted with 132 people identified the use of 107 medicinal plants, of which only 34% are native. The health disorders for which medicinal plants are mainly used are gastrointestinal and respiratory problems. The most commonly used medicinal plant species are *Matricaria chamomilla*, *Lippia alba*, and *Zingiber officinale*. The family of plants with the highest number of species used as medicine is Lamiaceae. The majority of surveyed individuals learn about medicinal plants from their family members. A decrease in the number of medicinal plants is observed as the population becomes younger, with this difference being statistically significant between individuals under 40 years old and those over 80 years old. Costa Ricans use medicinal plants to avoid using allopathic drugs that they consider harmful.

Keywords: Medicinal plants, diseases, reasons for use, loss of knowledge

1. Introduction
Through their evolution, plants have developed a group of molecules that help them adapt to the environment, and therefore, their production varies according to environmental conditions. Environmental factors include biotic factors, such as bacterial infection and consumption by herbivores, among others, as well as abiotic factors, such as the amount of water and temperature. These molecules are called secondary metabolites [1]. Secondary metabolites, according to their chemical structure, have been classified into several groups, including alkaloids, coumarins, flavonoids, tannins, saponins, among others. Within each class, there are molecules that produce physiological effects, which, in some cases, can be used to treat diseases [2]. This is why medicinal plants have been used throughout human evolution, with evidence of their use dating back to Paleolithic times [3]. Plants with minimal processing were the primary source of medicinal products over time, until the development of synthetic medicines, which started displacing them in the treatment of various diseases [4]. However, in recent decades, their use has been recovering, partly due to globalization [5]. Globalization has led to an increase in knowledge, as well as the availability of new medicinal plants [6]. Therefore, the objective of this research is to identify the diversity of medicinal plants currently used by the Costa Rican population, including the species introduced in the last century, as well as the most commonly used species. Additionally, the research aims to identify the reasons for the utilization of medicinal plants. The perspective of the health sector considers this information relevant and interesting, as the use of medicinal plants is an ancestral practice that has been largely forgotten in the era of pharmaceuticals but has regained value in recent decades. This research will allow us to understand the variety of medicinal plants used in Costa Rica, a country known for its high biodiversity. In fact, our territory is home to 4.9% of the species of living beings described worldwide [7]. Equally valuable is the population's perception of medicinal plants, as it can contribute to the identification of new sources of medicinal products and the evaluation of their usage based on the feedback from individuals who have indicated their use. It is important to highlight that the utilization of medicinal plants should be approached with caution since some of their components may be toxic and/or interact with other medications. Therefore, the responsible and safe use of medicinal plants should be promoted through education and guidance provided by healthcare professionals.

2. Materials and methods
A minimum of 2 individuals per age category and per province who reported using medicinal

plants were interviewed to determine the species of plants used and their perception of their use. A total of 132 interviews were conducted with men and women from all provinces, including those aged 18-39 years, 40-59 years, 60-79 years, and individuals over 80 years old.

3. Results

A total of 132 interviews were conducted, with 54 participants being men and 78 being women. By province, 23 individuals were interviewed in San José, 20 in Alajuela, 19 in Cartago, 12 in Heredia, 18 in Guanacaste, 21 in Puntarenas, and 19 in Limón. In terms of age ranges, there were 33 participants aged 18-39, 39 participants aged 40-59, 32 participants aged 60-79, and 28 participants aged 80 and over.

According to educational attainment, 11 individuals have incomplete primary school, 27 have completed primary school, 27 have incomplete secondary school, 13 have a high school diploma, 17 have incomplete university education, 9 have a university bachelor's degree, 22 have university degrees, and 6 have postgraduate studies. Out of the total number of participants, 65 indicated that their relatives also consumed medicinal plants, distinct from the ones they consumed themselves, and 61 provided a list of the medicinal plants used by their relatives in recent years.

The primary health issues for which medicinal plants are used are gastrointestinal disorders (digestive problems, gastritis, colitis, among others), as well as respiratory disorders (flu, asthma, cough, among others). The graph below illustrates the various health problems for which medicinal plants have been utilized.

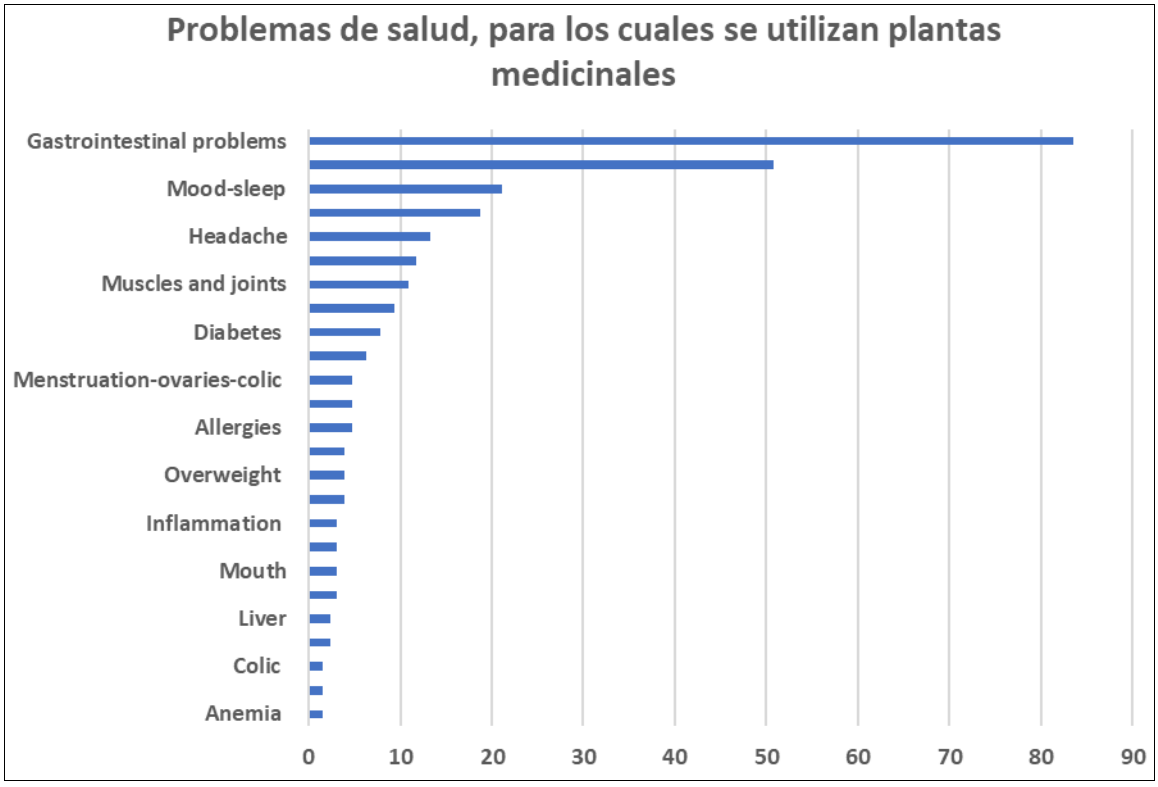

Fig 1: Health problems for which medicinal plants are used by respondents

When statistical analysis was performed to determine whether there is an association between the variables sex, age, schooling, or province of origin and the type of health problems for which medicinal plants are used, no statistically significant difference was found.

During the interviews conducted, participants mentioned 107 common names of medicinal plant species used by themselves or their relatives, out of which the scientific names of 104 species were determined. These species were distributed among 49 taxonomic families. Among the 104 species, 3 are not cultivated within the country but are imported for sale in supermarkets and macrobiotics. Additionally, although barley is naturalized, the malt obtained from this cereal is imported.

Out of the total number of plant species identified, 49 plant species were used by 3 or more people (2% of the sample), 14 species were used by only 2 people (1.5%), and 39 species were used by only 1 person in the sample (0.8%). The most commonly used plant species are chamomile and juanilama. The table below presents the list of plants reported by the sample, along with the percentage of use and other relevant data.

Table 1: Medicinal plants used by 2% or more of the 131 respondents and the family members of 61 respondents.

Common name in Costa Rica	Persons	Family	Species	Provenance	Source Availability	Bibliographic Source
Manzanilla	70,5	Asteráceae	*Matricaria chamomilla*	Eurasia	Cultivated	[9]
Juanilama	56,8	Verbenaceae	*Lippia alba*	South United States - Argentina and Antilles	Cultivated	[10]
Jengibre	47,7	Zingiberaceae	*Zingiber officinale*	Southeast Asian	Cultivated	[9]
Aloe vera	44,7	Liliaceae	*Aloe vera*	Africa	Cultivated	[10]
Romero	40,9	Lamiaceae	*Salvia rosmarinus*	Europe	Cultivated	[10]
Menta	37,1	Lamiaceae	*Satureja viminea*	Europe	Cultivated	[10]
Orégano	28	Lamiaceae	*Lippia graveolens*	Native	Cultivated	[11]

Sorosí	25,8	Cucurbitaceae	*Momordica charantia*	Tropical africa	Naturalized	[9]
Hombre grande	19,7	Simaroubaceae	*Quassia amara*	Native	Cultivated	[12]
Zacate de limón	18,2	Poaceae	*Cymbopogon citratus*	Asia	Cultivated	[9]
Hierba buena	17,4	Lamiaceae	*Mentha arvensis*	Europe	Cultivated	[10]
Eucalipto	12,9	Myrtaceae	*Eucalyptus sp.*	Australia	Cultivated	[10]
Guayaba	12,1	Myrtaceae	*Psidium guajaba*	Native	Wild	[11]
Canela	11,4	Lauraceae	*Cinnamomum verum*	India, Sri Lanka and Burma	Micro-scale cultivation	[9]
Ajo	10,6	Liliaceae	*Allium sativum L*	Central Asia	Cultivated	[9]
Cúrcuma	10,6	Zingiberaceae	*Curcuma longa*	Southeast Asia and India	Cultivated	[10]
Ruda	9,8	Rutaceae	*Ruta graveolens*	Europe	Cultivated	[9]
Limón	9,1	Rutaceae	*Citrus aurantifolia*	Eastern Asia	Cultivated	[9]
Guanábana	7,6	Annonaceae	*Annona muricata*	South America	Cultivated	[9]
Tomillo	7,6	Lamiaceae	*Thymus vulgaris*	Mediterranean region	Cultivated	[9]
Carao	6,8	Fabaceae	*Cassia grandis*	Native	Cultivated	[13]
Insulina	6,8	Acanthaceae	*Justicia spicigera*	Native	Micro-scale cultivation	[13]
Cola de caballo	6,1	Equisetaceae	*Equisetum giganteum*	Native	Wild	[15]
Diente de león	6,1	Asteráceae	*Taraxacum officinale*	Europe	Naturalized	[10]
Indio desnudo	5,3	Burseraceae	*Bursera simaruba*	Native	Wild	[13]
Tilo	5,3	Acanthaceae	*Justicia pecloralis*	Native	Cultivated	[11]
Linasa	5,3	Linaceae	*Linum usitatissimum*	Mediterranean Region and Southwest Asia	Naturalized	[9]
Mango	5,3	Anacardiaceae	*Mangifera indica*	Tropical asia	Cultivated	[9]
Gavilana	5,3	Asteráceae	*Neurolaena lobata*	Native	Wild	[11]
Mozote y mosotillo	4,5	Asteráceae	*Bidens pilosa*	Native	Wild	[13]
Cuculmeca	4,5	Smilacaceae	*Smilax dominguensis*	Native	Cultivated	[10]
Papaya	3,8	Caricaceae	*Carica papaya*	Native	Cultivated	[11]
Culantro coyote	3,8	Apiaceae	*Eryngium foetidum*	Native	Cultivated	[10]
Naranjo agrio	3	Rutaceae	*Citrus × aurantium*	Eastern Asia	Cultivated	[9]
Naranja	3	Rutaceae	*Citrus × sinensis*	Eastern Asia	Cultivated	[9]
Amapola	3	Malvaceae	*Hibiscus rosa-sinensis*	Asia	Cultivated	[13]
Malva	3	Malvaceae	*Malva parviflora*	Mediterranean and Indian	Naturalized	[9]
Noni	3	Rubiaceae	*Morinda citrifolia*	Eastern Asia	Cultivated	[9]
Moringa	3	Moringaceae	*Moringa oleifera*	India	Cultivated	[9]
Aguacate	3	Lauraceae	*Persea americana*	Native	Cultivated	[16]
Saragundí	3	Fabaceae	*Senna reticulata*	Native	Wild	[11]
Almendro	3	Combretaceae	*Terminalia catapa*	Asia and Oceania	Naturalized	[13]
Cebolla morada	2,3	Amaryllidaceae	*Allium cepa*	South of Europe	Cultivated	[9]
Remolacha	2,3	Amaranthaceae	*Beta vulgaris*	Europe and western asia	Cultivated	[9]
Targua	2,3	Euphorbiaceae	*Croton draco*	Native	Wild	[13]
Nuez moscada	2,3	Myristicaceae	*Myristica fragrans*	Indonesia	Cultivated	[9]
Anisillo/Hoja santa/Yerba santa	2,3	Piperaceae	*Piper auritum*	Native	Wild	[13]
Llantén	2,3	Plantaginaceae	*Plantago sp*	Eurasia	Naturalized	[9]
Salvia	2,3	Lamiaceae	*Salvia officinalis*	Mediterranean region	Micro-scale cultivation	[9]
Ortiga	2,3	Urticaceae	*Urtica sp*	Native	Wild	[11]
Maíz	2,3	Poaceae	*Zea mays*	Native	Cultivated	[17]
Piña	1,5	Bromeliaceae	*Ananas comosus*	South America	Cultivated	[9]
Bambú	1,5	Poaceae	*Bambusa sp*	Asia	Imported	[9]
Ciprés	1,5	Cupressaceae	*Cupressus lusitánica*	Mexico-Nicaragua	Cultivated	[9]
Guapinol	1,5	Fabaceae	*Cynometra hemitomophylla*	Mexico-Belize	Cultivated	[13]
Lengua de sapo	1,5	Acanthaceae	*Elytraria bromoides*	Native	Wild	[18]
Madero negro	1,5	Fabaceae	*Gliricidia sepium*	Native	Wild	[13]
Malta	1,5	Poaceae	*Hordeum vulgare*	Asia	Imported	[19]
Lechuga	1,5	Asteráceae	*Lactuca sativa*	Mediterranean region to Asia	Cultivated	[9]
Laurel	1,5	Lauraceae	*Laurus nobilis*	Mediterranean	Imported	[9]
Mas tuerso	1,5	Brassicaceae	*Lepidium virginicum*	Mexico to Canada	Naturalized	[9]
Dormilona	1,5	Fabaceae	*Mimosa pudica*	Native	Wild	[20]
Albahaca	1,5	Lamiaceae	*Ocimum basilicum*	Tropical asia	Cultivated	[9]
Arroz	1,5	Poaceae	*Oryza sativa*	Eastern Asia	Cultivated	[9]
Clavo de olor	1,5	Myrtaceae	*Syzygium aromaticum*	Indonesia	Micro-scale cultivation	[21]
Ocró	0,8	Malvaceae	*Abelmoschus esculentus*	Africa	Micro-scale cultivation	[9]
Sen	0,8	Fabaceae	*Acassia angustifolia*	India and North Africa	Imported	[22]
Coyol	0,8	Arecaceae	*Acrocomia aculeata*	Native	Grown	[23]
Solda con solda	0,8	Basellaceae	*Anredera cordifolia*	South of South America	Naturalized	[9]
Apio	0,8	Apiaceae	*Apium graveolens*	Europe	Cultivated	[9]
Árnica	0,8	Asteráceae	*Árnica sp*	Europe	Micro-scale cultivation	[24]
Fruta de pan	0,8	Moraceae	*Artocarpus altilis*	Indonesia	Naturalized	[9]
Avena	0,8	Poaceae	*Avena sativa*	Asia Minor	Cultivated	[23]
Veranera	0,8	Nyctaginaceae	*Bouganvillea glabra*	South America	Cultivated	[13]
Canabis	0,8	Cannabaceae	*Cannabis sativa*	Eastern Asia	Cáñamo cultivated	[9]
Caña fístula	0,8	Fabaceae	*Cassia fistula*	Tropical asia	Cultivated	[9]
Guarumo	0,8	Urticaceae?	*Cecropia peltata*	Mexico to North America	Wild	[11]
Limón dulce	0,8	Rutaceae	*Citrus limetta*	Eastern Asia	Cultivated	[9]
Pipa	0,8	Arecaceae	*Cocos nucifera*	Tropical asia	Cultivated	[9]
Culantro castilla	0,8	Apiaceae	*Coriandrum sativum*	Europe	Cultivated	[9]
Caña agria	0,8	Costaceae	*Costus spicatus*	Native	Wild	[10]
Jícaro	0,8	Bignoniaceae	*Crescentia cujete*	Native	Cultivated	[13]
Semillas ciprés	0,8	Cupressaceae	*Cupressus sempervirens*	Eastern Mediterranean and South West Asia	Cultivated	[9]
Apazote	0,8	Amaranthaceae	*Dysphania anthelmintica*	Native	Wild	[26]

Jamaica	0,8	Malvaceae	*Hibiscus sabdariffa*	South india and africa	Cultivated	[27]
Frailecillo	0,8	Euphorbiaceae	*Jatropha gossypiifolia*	Native	Wild	[11]
Azul de mata	0,8	Acanthaceae	*Justicia tintoria*	Native	Grown	[10]
Lavanda	0,8	Lamiaceae	*Lavandula angustifolia*	Western Europe	Micro-scale cultivation	[9]
Melissa	0,8	Lamiaceae	*Melissa officinalis*	Mediterranean region	Micro-scale cultivation	[9]
Tabaco	0,8	Solanaceae	*Nicotiana tabacum*	Native	Cultivated	[9]
Gavilán	0,8	Fabaceae	*Pentaclethra macroloba*	Native	Cultivated	[16]
Rompe piedras	0,8	Phyllanthaceae	*Phyllanthus niruri*	Native	Wild	[28]
Anis	0,8	Apiaceae	*Pimpinella anisum*	Eastern Mediterranean and South West Asia	Cultivated	[9]
Chayote	0,8	Cucurbitaceae	*Sechium edule*	Mexico	Cultivated	[9]
Cardo mariano	0,8	Asteráceae	*Silybum marianum*	Europe	Micro-scale cultivation	[29]
Papa	0,8	Solanaceae	*Solanum tuberosum*	Peru and Bolivia	Cultivated	[9]
Cacao	0,8	Strculiaceae	*Theobroma cacao*	Amazon	Cultivated	[13]
Cucarachilla-Cucaracha	0,8	Commelinaceae	*Tradescantia zebrina*	Europe	Cultivated-ornamental	[10]
Caraño cáscara	0,8	Burseraceae	*Trattinnickia aspera*	Native	Wild	[16]
Uña de gato	0,8	Rubiaceae	*Uncaria tomentosa*	Native	Cultivated	[11]
Vainilla	0,8	Vainilla	*Vainilla planifolia*	Native	Cultivated	[30]
Valeriana	0,8	Caprifoliaceae	*Valeriana officinalis*	Europe and western asia	Micro-scale cultivation	[9]
Verbena	0,8	Verbenaceae	*Verbena officinalis*	Europe	Micro-scale cultivation	[31]
Itabo	0,8	Asparagaceae	*Yucca giganea*	Nativa	Cultivated	[9]

*Malt is germinated and dried barley, this product is imported.

The plant family with the highest number of medicinal species used is Lamiaceae, followed by Asteraceae. The graph below illustrates the number of medicinal plant species categorized by taxonomic family.

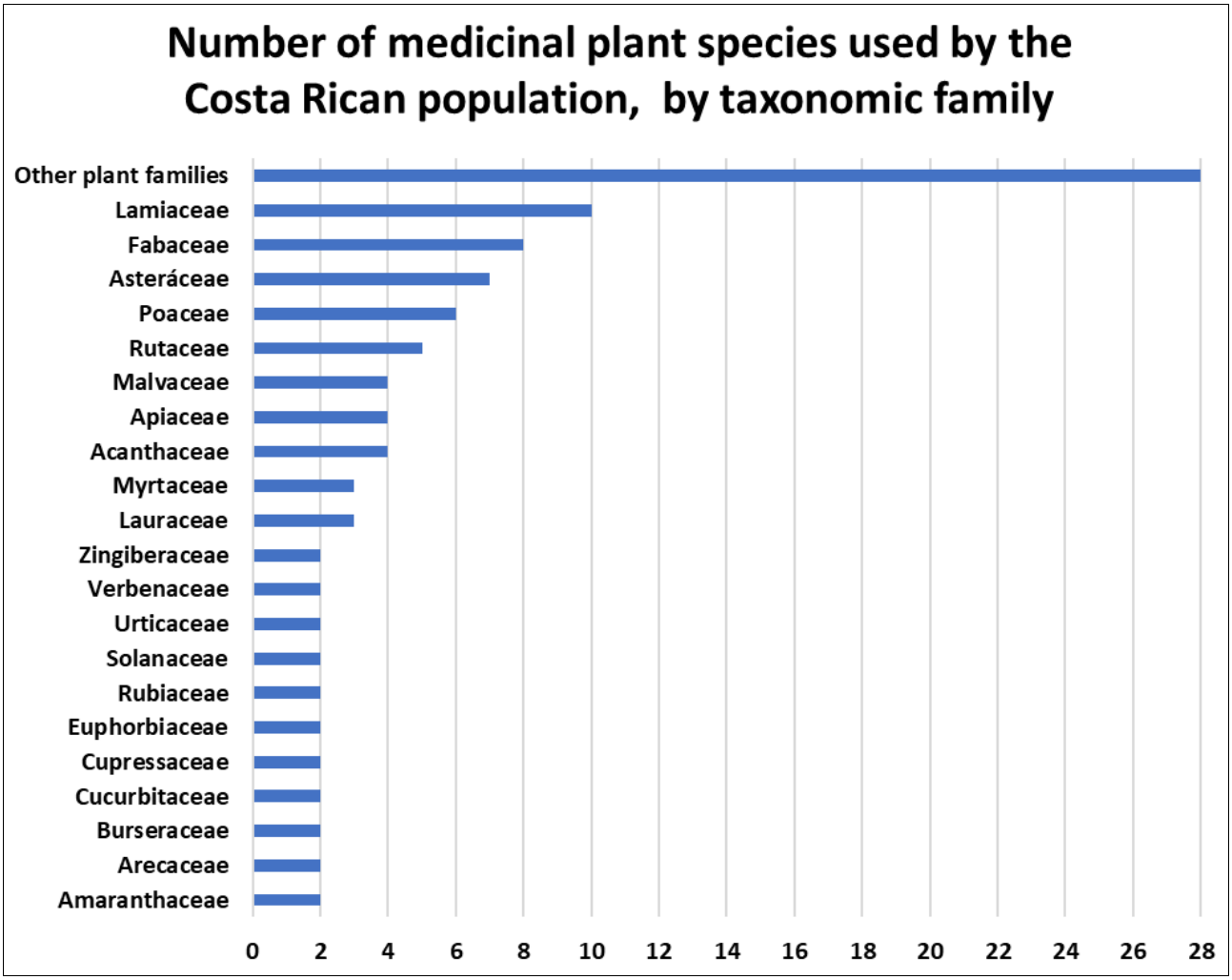

Fig 2: The species of medicinal plants used by the sample of Costa Ricans and their relatives were identified. Plant families where 2 or more species were mentioned are indicated. In the “Other plant families" category, there is only one species per family.

The geographical origin of the medicinal species used by the interviewees was investigated. The following graph shows the percentage according to area of origin.

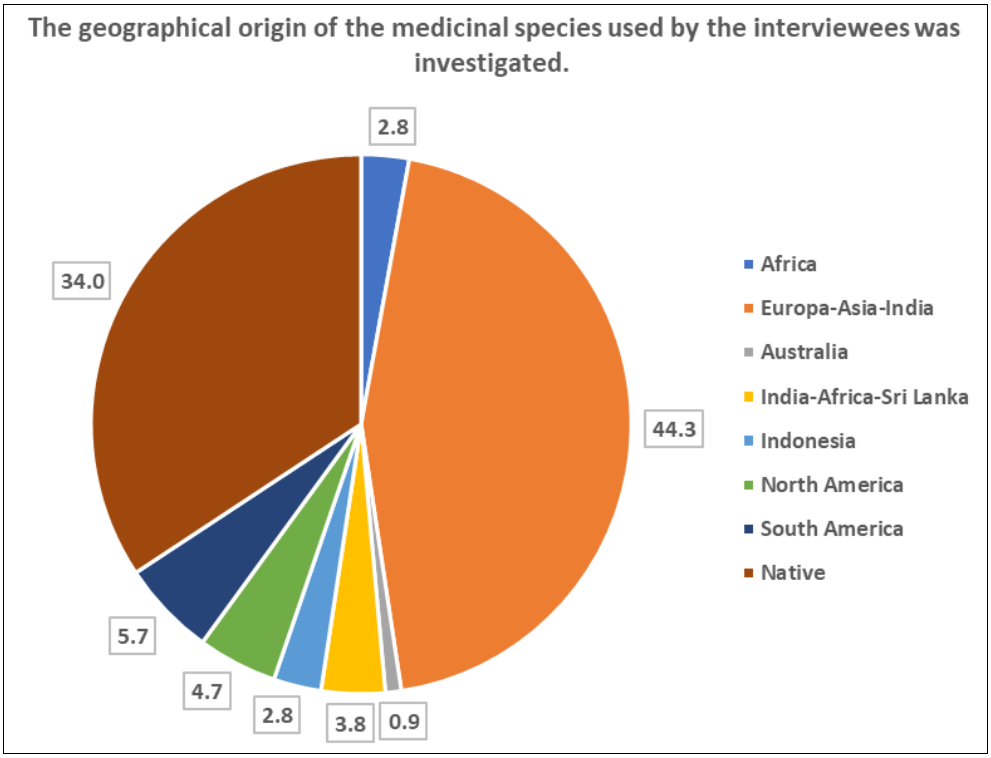

Fig 3: Geographical origin of the medicinal plant species used by the Costa Rican population.

Only 34% of the species used by the interviewed individuals were found to be native to Costa Rica. An analysis was conducted to determine if there was a relationship between the usage of medicinal species based on their nativity (native or non-native). The data is presented in the graph below.

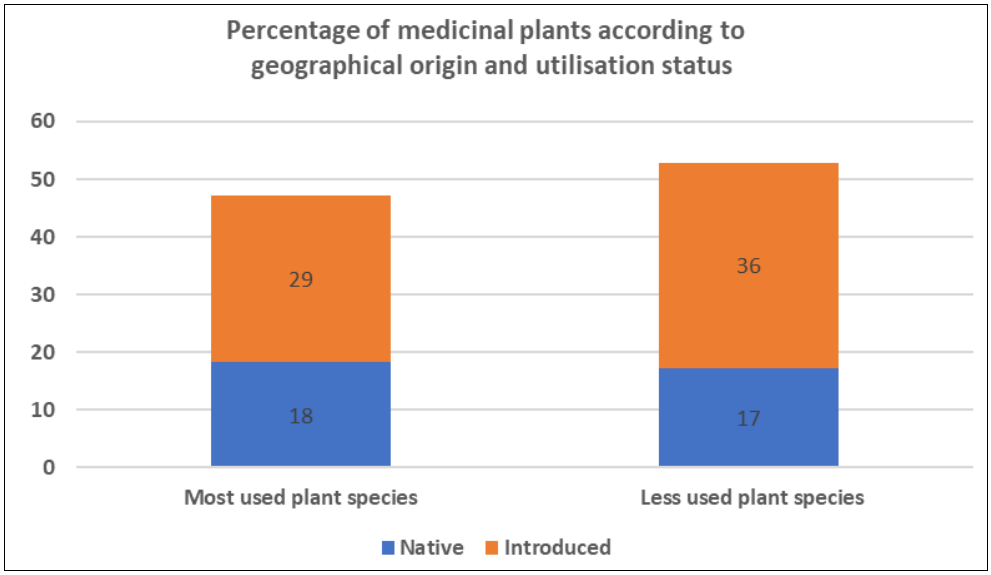

Fig 4: Percentage of plant species used according to the status of native or introduced plants. High consumption species were considered to be those where 2% (3 persons) or more of the sample used such species, and low consumption species where only 1 or 2 persons mentioned their use. The "Introduced" category included the 3 species that are imported and malt. There is no statistical difference between the groups.

No statistically significant difference was found in the percentage of people using medicinal plant species based on whether they are introduced or native. The graph below illustrates the percentage of medicinal species used categorized by their nativity (native or introduced from other geographical areas) and whether they are cultivated.

Furthermore, an analysis was conducted to determine if there was a difference in the cultivation of medicinal plants based on whether they were native or non-native. The graph presents the relevant information.

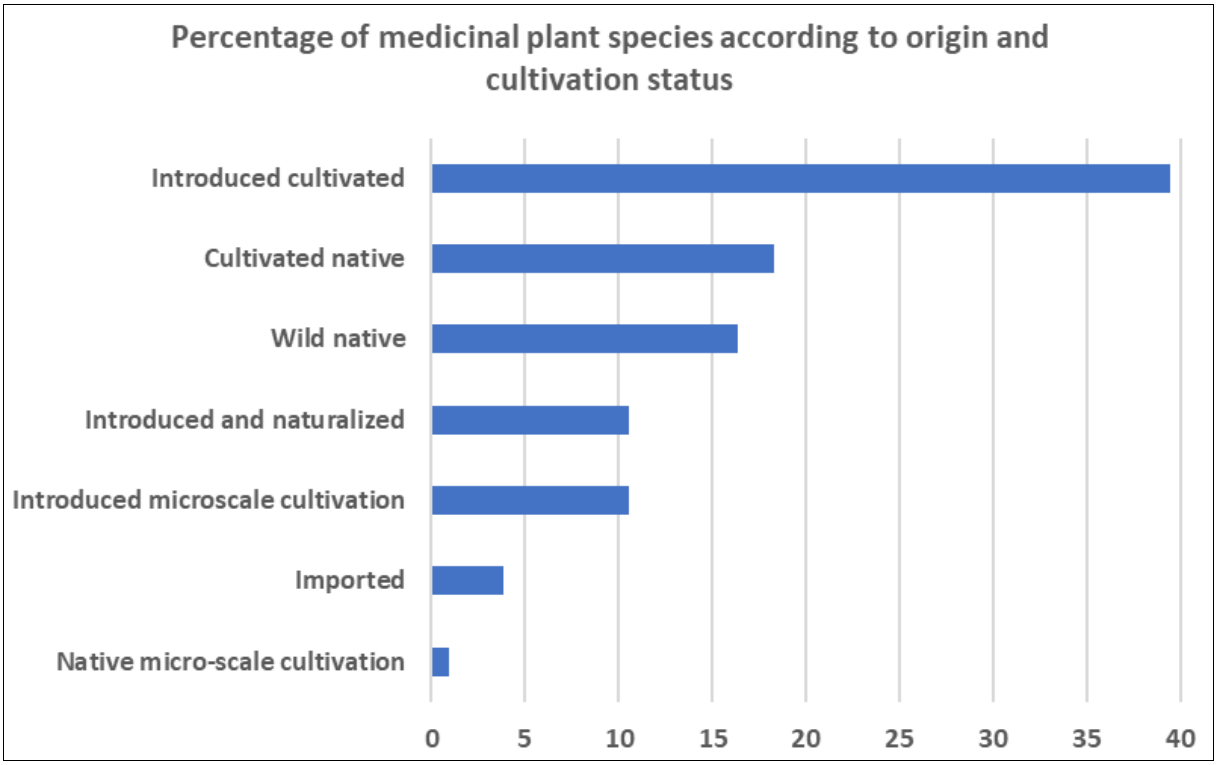

Fig 5: Percentage of medicinal plant species, which are cultivated, according to whether they are native or introduced. Micro-scale cultivation refers to planting at home, in botanical gardens and in nurseries. Introduced plants refer to parts of plants that are imported and sold in supermarkets, and macrobiotics. There is no statistical difference between the groups.

We investigated whether there is a relationship between the number of different medicinal plants used and the age range of the participants, as well as other socio-demographic variables. The graph below illustrates the findings.

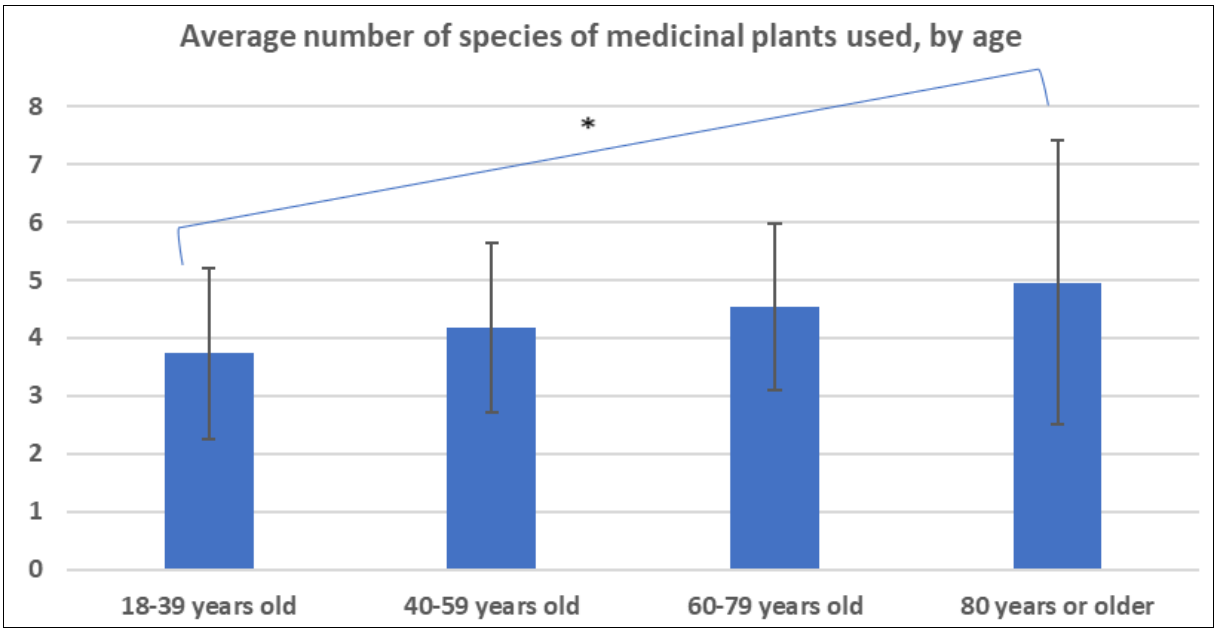

Fig 6: Average number of medicinal plant species used according to age range. * $p < 0,05$

There is no statistically significant difference between the number of medicinal plants used and the variables of sex, schooling, province of residence, or whether the person has lived in a rural area or not. However, a statistically significant difference was found in relation to age. Individuals aged 18-39 years use fewer medicinal plants compared to those aged 80 years and over (ANOVA = 0.040; Tukey post hoc test = 0.030).

The sources from which Costa Ricans learn about medicinal plants have been determined. The graph below presents the data.

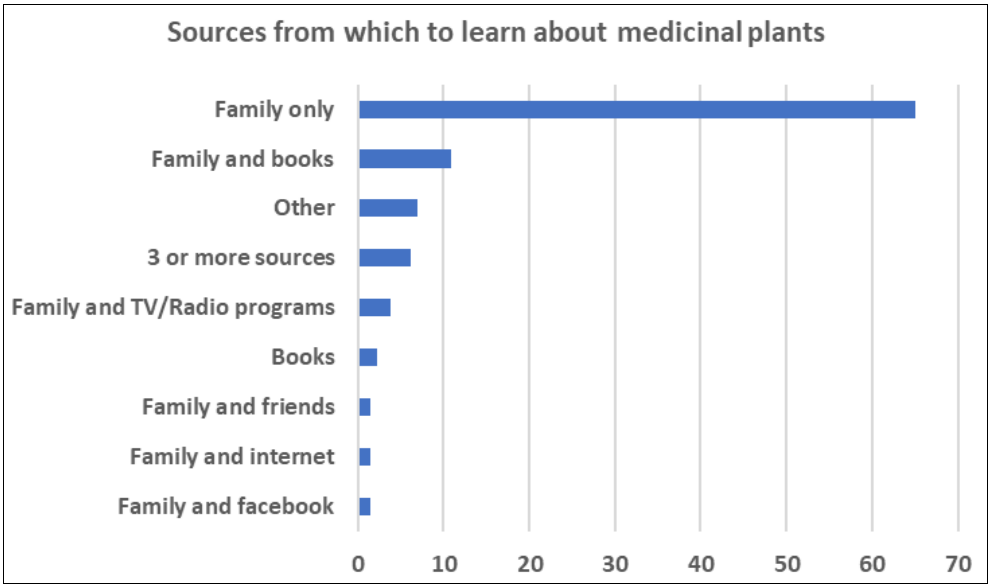

Fig 7: Sources of information from which the 129 respondents learned about the medicinal plants they use

The graph shows that the family is the main source of knowledge on this subject.

A very important fact in the health sector is the reason why the Costa Rican population uses medicinal plants. Here are the results.

Table 2: Reasons why people prefer the consumption of medicinal plants, therefore an open question was asked.

Reasons	N. Persons	%
They are quicker to heal	2	1,7
Because they are God-given	2	1,7
They are not addictive	2	1,7
They are cheaper	3	2,5
Preventive	4	3,3
Why they work-they are more effective/treating diseases	5	4,2
They are more readily available	11	9,2
Tradition	12	10,0
Other	14	11,7
Because they are from nature/no chemicals	30	25,0
Which are safe to use/avoid using allopathic medicines	48	40,0

The primary reason Costa Ricans choose to use medicinal plants is to avoid the use of allopathic medicines, as they are considered unsafe due to their many side effects.

4. Discussion

In the present study, digestive and respiratory disorders were identified as the most common ailments treated through the use of medicinal plants, as depicted in Figure 1. In Costa Rica, gastrointestinal problems and respiratory conditions also represent the primary reasons for consultations in community pharmacies [8]. The utilization of medicinal plants for the treatment of gastrointestinal disorders is not unique to Costa Rica but has been observed as a common practice in other countries such as Morocco and Mexico [32, 33]. Although medicinal plants are employed to treat a wide range of ailments worldwide, gastrointestinal disorders continue to be one of the most prevalent conditions for which medicinal plants are used.

The most commonly used medicinal plant is *Chamomile*, which is among the widely utilized species globally (refer to Table 1) [34]. The plant families with the highest number of medicinal species used, in descending order, are Lamiaceae, Fabaceae, and Asteraceae, similar to the situation in Brazil (see Fig. 2) [35]. However, this differs from other Latin American countries like Peru, where the families with the most utilized medicinal plants are Asteraceae, Geraniaceae, and Urticaceae [36].

In Costa Rica, a sample of 132 individuals provided the common names of 107 species of medicinal plants, of which the scientific names of 104 were identified. These plants were used by the participants or their relatives in recent years (refer to Table 1). This diversity of medicinal plants aligns with findings in African and Asian countries. For instance, a study conducted in Anatolian populations in Turkey indicated the use of 99 medicinal plant species [37], while a sample of 225 households in northern Pakistan reported the use of 98 species [38]. In Tarfaya, Morocco, the use of 130 medicinal plants was identified [33]. However, in Latin American populations with a significant percentage of indigenous people, the number is much higher. In the population of Oaxaca, Mexico, a sample of 164 families reported the use of 1032 medicinal plants [32].

Out of the total number of plants cited, only 34% are native species (see Fig. 3), which is consistent with a study conducted by González-Ball and colleagues [10] in 61 gardens in Heredia, Costa Rica, where 33% of the cultivated medicinal plants were native. This percentage is similar to that of populations in Pernambuco, Brazil, where only 40% of both edible and medicinal plants are native [39]. However, in populations with a high percentage of native population such as Oaxaca, Mexico, the percentage is more than double, with 75% of the medicinal plants used being native [40].

There is a predominant use of introduced medicinal plants (62%), compared to native plants, although this difference is not statistically significant (see Fig. 4). This trend differs from that of indigenous populations, where there is a clear preference for the use of native medicinal plants, as observed in Velliangiri, India [41], or in communities in Rio Jauaperi, Brazil, where only 42% are introduced [42]. The preference for introduced plants can be explained by the fact that most of the cultivated medicinal species in the country are introduced, making them easily accessible (see Fig. 5).

Of the medicinal plants mentioned by the interviewed individuals, three species are either not found or found in very small quantities in Costa Rica, necessitating their import from other countries. These plants include bamboo species, laurel leaves (*Laurus nobilis*), and senna leaves (*Cassia angustifolia*) [9, 22]. Additionally, malt, which is derived from

barley (Hordeum vulgare), is also imported.

Barley, a cereal with numerous health benefits and a staple food worldwide, was once cultivated on a large scale in Costa Rica during the 1930s and 1940s to meet human food demand. However, its cultivation subsequently declined, and it is currently only grown for animal use [43- 44].

Regarding the number of different medicinal plant species used by the interviewees, there is a tendency for the number to decrease as age decreases. This difference is statistically significant between the group of people aged 18-30 years and those aged 80 years and over (refer to Fig. 6). The decline in ethnobotanical knowledge is a global trend, with older individuals possessing more knowledge about medicinal plants, resulting in a greater diversity of species used [45].

Costa Ricans primarily learn about medicinal plants from family members, particularly grandparents and parents (refer to Fig. 7). Family members serve as the exclusive source of knowledge for 65% of the interviewed individuals. A smaller percentage acquire knowledge from both family members and other sources such as books, radio, television, and the internet. Only 9% learned everything they know about medicinal plants from sources other than the family. The family's role as the primary source of ethnobotanical knowledge is also observed in other societies, such as on the French island of Grande-Terre, where 56.8% of 118 interviewed individuals cited the family as their sole source of knowledge on this subject [46].

When asked about the reasons for using medicinal plants, 40% of respondents consider the safety of plants and the avoidance of allopathic medicines as the main reasons. Additionally, 25% expressed concerns about the presence of chemicals in allopathic medicines, which is related to the first reason (refer to Table 2). These findings align with research conducted in other regions of the world, such as the UK, where a similar trend in the choice of medicinal plants for similar reasons has been reported [47].

In the Costa Rican population, the economic factor is not a significant reason for preferring the use of medicinal plants over allopathic medicines. Only 2.5% of the surveyed sample mentioned this as a reason. In contrast, in other populations, such as in North Sumatra, Indonesia, 5% of 200 people interviewed considered the economic factor important, and in Nigeria, 75% of the population uses medicinal plants to treat conditions like hypertension and diabetes due to economic reasons [48, 49].

The difference in preference for medicinal plants based on the economic variable between countries like Nigeria and Costa Rica can be largely attributed to the presence of a universal health system in Costa Rica. The country's health system includes primary health care, as well as disease prevention and promotion measures [50]. This comprehensive coverage, with a rate of 94.4% of the population covered in 2016, enables citizens to access the necessary medications for treating their health issues [51]. The easy and widespread access to healthcare in Costa Rica may explain why Costa Ricans turn to medicinal plants for reasons other than affordability, in contrast to countries where access to healthcare and medicines is more limited.

Research on medicinal plants is a valuable tool for identifying treatments and evaluating ancestral health practices. It is important to promote the responsible and safe use of medicinal plants by fostering dialogue and collaboration between the population and healthcare professionals. The healthcare sector has a responsibility to lead in this regard, with the pharmaceutical industry playing a role in funding research and adhering to good documentation practices under a quality management system. Sharing data transparently can also aid other researchers in building upon previous results and accelerating the development of new treatments, ultimately benefiting public health.

5. Conclusions

In Costa Rica, despite the country's abundant biological diversity, a significant portion of the medicinal plant species used actually originates from other parts of the world. This indicates a reliance on imported plants rather than utilizing the local biodiversity.

Family members play a crucial role as the primary source of knowledge about medicinal plants for most Costa Ricans. This highlights the cultural transmission of traditional medicinal knowledge within families.

There is a concerning trend among younger generations, as they appear to be losing knowledge about medicinal plants. This is evident from the lower number of medicinal species they use compared to older age groups. The difference is statistically significant between individuals aged 80 years and over and adults under 40 years of age. This loss of knowledge can have implications for the preservation of traditional practices and the diversity of medicinal plant use.

The primary reason for using medicinal plants in Costa Rica is to avoid the consumption of allopathic medicines. Many Costa Ricans prefer medicinal plants due to concerns about the safety and side effects associated with allopathic medications. This aligns with the global trend of seeking natural alternatives and avoiding potentially harmful pharmaceuticals.

Overall, these findings emphasize the need to preserve traditional knowledge, promote the sustainable use of local medicinal plants, and raise awareness about the potential benefits and risks associated with different healthcare options, including allopathic medicines and traditional herbal remedies.

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